

What is claimed is:

1. A vehicle brake control apparatus comprising:

5 a brake commanding element for making a judgment based on input information as to whether a vehicle should decelerate or not and for generating a brake command when it is determined that the vehicle should decelerate;

a braking element for applying brake on the vehicle with a predetermined braking force corresponding to said brake command  
10 generated by said brake commanding element; and

a braking force restricting element for restricting a maximum value of said braking force to be generated by said braking element in response to said brake command to a value smaller by a predetermined ratio than an estimated maximum braking force being estimated based on information  
15 relating to a road surface friction coefficient.

2. The vehicle brake control apparatus in accordance with claim 1, wherein

said brake commanding element commands an automatic brake  
20 operation carried out for automatically decelerating the vehicle when it is judged that there is a prospective danger of vehicle collision or there is a necessity of securing safety of the vehicle based on entered collision danger information relating to collision danger of the vehicle relative to a forward obstacle or relevant information for vehicle safety, and

25 said braking force restricting element sets a maximum value of an automatic braking force, being said braking force to be generated by said braking element during said automatic brake operation, to a value smaller by a predetermined ratio than said estimated maximum braking force.

30 3. The vehicle brake control apparatus in accordance with claim 2,

wherein said braking force restricting element sets a maximum value of said automatic braking force to somewhere in a range corresponding to 5% to 60% of said estimated maximum braking force.

5           4. The vehicle brake control apparatus in accordance with claim 2,  
wherein said braking force restricting element sets a braking force higher  
than an inherent braking force corresponding to a manual brake operation  
amount, within the range of said estimated maximum braking force being  
estimated based on said road surface friction coefficient, when a manual  
10   braking operation is carried out during said automatic brake operation.

          5. The vehicle brake control apparatus in accordance with claim 2,  
wherein said braking force restricting element sets a braking force higher  
than an inherent braking force corresponding to a manual brake operation  
15   amount, regardless of said estimated maximum braking force, when a  
manual braking operation is carried out during said automatic brake  
operation.

          6. The vehicle brake control apparatus in accordance with claim 2,  
20   wherein said braking force restricting element increases said braking force  
within the range of said estimated maximum braking force, when a driver  
applies none of manual braking, manual steering, and manual accelerating  
operations when a predetermined time has elapsed after said automatic brake  
operation is started.

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          7. The vehicle brake control apparatus in accordance with claim 1,  
wherein said braking force restricting element allows the automatic brake  
operation in which the braking force is maximized when it is judged that the  
possibility of avoiding vehicle collision by steering is lower than a  
30   predetermined rate.

8. The vehicle brake control apparatus in accordance with claim 1,  
wherein

said brake commanding element commands a warning brake  
5 operation carried out for decelerating the vehicle as a warning given to a  
driver when it is judged that there is a prospective danger of vehicle  
collision or there is a necessity of securing safety of the vehicle based on  
entered collision danger information relating to collision danger of the  
vehicle relative to a forward obstacle or relevant information for vehicle  
10 safety, and

said braking force restricting element sets a maximum value of a  
warning braking force, being said braking force to be generated by said  
braking element during said warning brake operation, to a value smaller by a  
predetermined ratio than said estimated maximum braking force.

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9. The vehicle brake control apparatus in accordance with claim 8,  
wherein said braking force restricting element sets a maximum value of said  
warning braking force to somewhere in a range corresponding to 5% to 60%  
of said estimated maximum braking force.

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10. The vehicle brake control apparatus in accordance with claim 8,  
wherein said braking force restricting element sets a braking force higher  
than an inherent braking force corresponding to a manual brake operation  
amount, within the range of said estimated maximum braking force being  
25 estimated based on said road surface friction coefficient, when a manual  
braking operation is carried out during said warning brake operation.

11. The vehicle brake control apparatus in accordance with claim 8,  
wherein said braking force restricting element sets a braking force higher  
30 than an inherent braking force corresponding to a manual brake operation

amount, regardless of said estimated maximum braking force, when a manual braking operation is carried out during said warning brake operation.

12. The vehicle brake control apparatus in accordance with claim 8,  
5 wherein said braking force restricting element increases said braking force within the range of said estimated maximum braking force, when a driver applies none of manual braking, manual steering, and manual accelerating operations when a predetermined time has elapsed after said warning brake operation is started.

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13. A method for controlling an automatic vehicle braking apparatus comprising the steps of:

judging as to whether a vehicle should decelerate or not;

restricting a maximum value of a braking force to be generated by  
15 said automatic vehicle braking apparatus to a value smaller by a predetermined ratio than an estimated maximum braking force being estimated based on information relating to a road surface friction coefficient;

generating a brake command with reference to said maximum value of the braking force to be generated by said automatic vehicle braking  
20 apparatus, when it is determined that the vehicle should decelerate; and

actuating said automatic vehicle braking apparatus to apply brake on the vehicle in accordance with said brake command, thereby carrying out an automatic brake operation.

25 14. The method for controlling an automatic vehicle braking apparatus in accordance with claim 13, wherein the maximum value of the braking force to be generated by said automatic vehicle braking apparatus is set to somewhere in a range corresponding to 5% to 60% of said estimated maximum braking force.

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15. The method for controlling an automatic vehicle braking apparatus in accordance with claim 13, wherein the braking force to be generated by said automatic vehicle braking apparatus is set to be higher than an inherent braking force corresponding to a manual brake operation  
5 amount when a manual braking operation is performed during said automatic brake operation.

16. The method for controlling an automatic vehicle braking apparatus in accordance with claim 13, wherein the braking force to be  
10 generated by said automatic vehicle braking apparatus is increased within the range of said estimated maximum braking force, when a driver applies none of manual braking, manual steering, and manual accelerating operations when a predetermined time has elapsed after said automatic brake operation or said warning brake operation is started.

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17. The method for controlling an automatic vehicle braking apparatus in accordance with claim 13, wherein the automatic brake operation is carried out with a maximized braking force when it is judged that the possibility of avoiding vehicle collision by steering is lower than a  
20 predetermined rate.